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ABSTRACT

This paper investigates the usability of educational metadata schemas with respect to the case of the MALTED (Multimedia Authoring Language Teachers and Educational Developers) project at University College London (UCL). The project aims to facilitate authoring of multimedia materials for language learning by allowing teachers to share multimedia materials for language teaching, and offering a comparatively easy interface for retrieving materials and composing exercises and courses from them. Although a brief description of the MALTED system is given, the paper focuses on usability problems encountered by the project during the development of the MALTED system. The work finds that there are serious incompatibilities between the current educational metadata schema, as promoted by the Learning Object Metadata (LOM) working group of the IEEE Learning Technologies Standardization Committee, and the way language teachers actually go about authoring teaching materials. (Author)

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There's Trouble in Paradise: Problems with Educational Metadata Encountered during the MALTED Project

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Abstract: This paper investigates the usability of educational metadata schemas with respect to the case of the MALTED (Multimedia Authoring for Language Teachers and Educational Developers) project at University College London (UCL). The project aims to facilitate authoring of multimedia materials for language learning by allowing teachers to share multimedia materials for language teaching, and offering a comparatively easy interface for retrieving materials and composing exercises and courses from them. Although a brief description of the MALTED system is given, the paper focuses on usability problems encountered by the project during the development of the MALTED system. This work finds that there are serious incompatibilities between the current educational metadata schema, as promoted by the Learning Object Metadata (LOM) working group of the IEEE Learning Technologies Standardization Committee, and the way language teachers actually go about authoring teaching materials.

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1 Introduction

1.1 Metadata

Metadata was introduced to facilitate searching for items not only via the items' technical attributes but also via additional information about the items. For example, web pages often contain metadata describing the content of the page, enabling search engines to determine the content of the page without having to search through the whole page. Consequently, rich metadata schema allows sophisticated or very specific search requests to be carried out.

1.2 Education and Metadata

The idea of searching for educational materials from external resources and reusing them is not new. Education professionals regularly use and reuse materials from outside their classrooms as part of their teaching materials, e.g., newspapers, videos, posters and other props. Educational metadata schemas, such as the one specified by the Learning Object Metadata (LOM) working group of the IEEE Learning Technologies Standardization Committee, aim to help teachers find the right multimedia materials that suit their pedagogic needs, by facilitating sharing of those materials among education professionals. LOM objectives go as far as to enable exercises to be automatically generated by computer agents that are given certain specific criteria. Consequently, LOM metadata schema is extensive. The schema archives a wide range of information concerning the materials, ranging from the description of the materials to the kind of student interactions the materials are authored for. This not only enables teachers to search for materials by subject or a particular course but also specifically by students of certain age, level of competence or the kind of interaction the teacher would like the multimedia material to use.

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Other related metadata projects aim to deal with the practical problems of LOM extensive schema by either creating a subset schema that is compatible with the more extensive LOM schema (e.g. ARIADNE) or creating an alternative lightweight schema (e.g. Dublin Core Metadata Initiative).

1.3 The MALTED Project

MALTED (Multimedia Authoring for Language Teachers and Educational Developers) is a European Commission-funded project led by University College London (UCL). The aim of the project is to facilitate authoring of multimedia materials for language learning. Computer-based multimedia exercises can enrich the self-study part of language learning, which requires a certain amount of drill-style practice, for several reasons:

1. By utilising sound, video and animation, a wider range of language skills can be exercised than through paper-based exercises.
2. Computer-based exercises provide immediate feedback to the learner.
3. Well-designed multimedia materials appeal to many learners and thus increase the amount of self-study.

For these reasons, many language teachers would like to utilise multimedia exercises. Authoring effective and attractive multimedia materials is, however, time-consuming and requires a level of computer skills that many teachers do not possess or have time to acquire. Building a time-telling exercise with an animated clock and sound clips, for example, can take many hours. MALTED aims to reduce the effort required to produce effective and attractive materials by allowing teachers to share multimedia materials for language teaching, and offering a comparatively easy interface for retrieving materials and composing exercises and courses from them. MALTED collects multimedia materials in a repository for re-use by other teachers. To allow teachers to identify suitable materials for a particular exercise, materials submitted to the shared repository have to be tagged. Without tagging, identifying suitable materials would require tedious and time-consuming scanning of long lists of materials in the repository. Since effective and efficient re-use of educational materials is at the core of MALTED, it offered a case study of educational metadata in action.

While this work will outline the technical implementation of the MALTED system (Section 2), the focus of the work will be on issues concerning usability of metadata from the point of view of language teachers at UCL who are using the MALTED system to author teaching materials for their courses (Section 3). In particular, the work will highlight serious incompatibilities between the metadata schema advocated by LOM and the processes that language teachers actually employ to author teaching materials (Section 4.1).

2 The MALTED System

2.1 System Architecture of MALTED

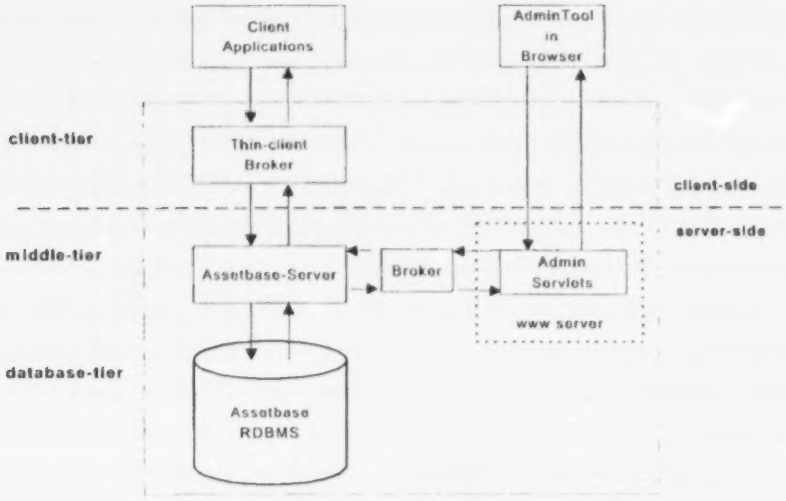

Figure 1: Simplified MALTED System Diagram

The MALTED system consists of three main parts: MALTED clients, MALTED assetbase and the database backend. Figure 1 presents a simplified system diagram of the whole MALTED system.

The client application provides an interface for teachers to access and manage materials or "assets" and their metadata via the MALTED assetbase, allowing them to perform tasks such as searching for and adding new assets to the back-end database. It is solely through this client application that teachers will interact with the MALTED assetbase. The client application also provides facilities for authoring and managing materials.

The assetbase performs the standardisation of metadata between the client and the database. This is accomplished by converting a database query or an update requested by the client in eXtensible Markup Language (XML) into the appropriate Structured Query Language (SQL) query or update for the database and vice versa. A custom data dictionary (DD) -- containing a mapping of XML attributes to database tables or views, with associated typing -- is used together with a Document Type Definition (DTD) to enable the assetbase to store the assets and their metadata in the appropriate place on the database. This gives the advantage of flexibility as different subsets can be used for different asset types. For example, technical information such as resolution is appropriate for a video or image file, but meaningless for a text file. The same data dictionary is used to create the XML files to return to the client following a query by extracting and combining data from multiple tables, where each XML file represents the metadata associated with a single asset.

A database is used to store assets and their metadata in order to optimise the speed of access for queries and to enable complex queries, which may be inefficient if carried out via XML, to be performed. While it is possible to use other database packages, the MALTED system uses Oracle, which communicates with the assetbase via JDBC (the assetbase having been written in JAVA).

3 Handling Metadata in MALTED

It is possible to achieve a number of LOM objectives directly through the use of metadata to tag educational material with relevant information on the material. The following LOM objectives (LOM, 2000) are particularly relevant when designing a system to handle metadata:

- To enable learners or instructors to search, evaluate, acquire, and utilize Learning Objects.
- To enable the sharing and exchange of Learning Objects across any technology supported learning systems.
- To enable the development of learning objects in units that can be combined and decomposed in meaningful ways.

Teachers using MALTED first encounter metadata when searching for assets on assetbases and then while contributing new assets to assetbases. The MALTED project has encountered some significant usability issues concerning metadata while implementing facilities to support these two tasks. The following issues were raised during both formal and informal interviews and focus groups with users of the MALTED system. Consequently, for this section, the term "user(s)" will refer to language teacher(s) at UCL, unless explicitly stated otherwise.

3.1 Searching via Metadata

From the user's point of view, metadata is first encountered when searching for materials on an assetbase. To support this task, MALTED provides a search dialogue in which the user specifies what to search for in which metadata field. At this stage, large number of fields in the metadata schema is very useful to the user as a large number of fields allow the user to very specifically define a search. For example, the user can search for assets for *French language* teaching at *first year undergraduate level* with *multiple-choice questions* as the interaction type for students whose mother tongue is *not French*. Even fields that have little or no pedagogic value can be of some use for the user – the fields for file size and format can be of use if the user is concerned with download time or compatibility issues.

After a search request has been submitted, the search result is then displayed to the user showing information about the assets structured by the metadata schema. Again, the fields in the metadata schema are useful for the user as the schema gives structure to the information on the materials. However, if all fields are displayed to the user at the same time, some information that are given to the user may be irrelevant and, if there are a large number of irrelevant fields, the user may experience information overload.

3.2 Tagging Material with Metadata

The rich and extensive metadata schema that helps the user search for and view asset information are, however, significant overheads for the user when he/she is adding new material to an assetbase. There are a significant number of usability problems concerning metadata that arises when the user performs this task.

3.2.1 Too many fields

The problem experienced by the user, at this particular stage, is not so much information overload, but information "over-demand". Although almost all of the fields are applicable (i.e. the material does have attributes which can be categorised by the field), they may not be important. Users feel that it is not necessary to identify all possible characteristics of the materials they are submitting to the assetbase, just the "relevant" or "important" ones. We found that such overhead imposed on the user could deter the user from using the system because it takes too much effort to share materials. Previous research (Davis 1993) (Fullan 1982) on the factors influencing implementation of educational technology strongly suggests that the user's perceived practicality of the system is one of the main factors to influence whether the system will be used or not. In the case of MALTED, the user was spending a lot of time filling in each field and also working out the most appropriate content of each field. MALTED users feel that this process takes far too long.

3.2.2 Ambiguous field names

Often the user is presented with two or more fields that, in their opinion, refer to the same attribute of the material they are trying to add. For example, users often consider the fields "Content" and "Description" to be the same. Consequently, the user finds it difficult to fill in some fields as it is felt that the information has already been entered in a previous field. As in the previous problem, the user feels that more work than necessary is being demanded of them by the system.

3.2.3 Irrelevant fields

Users often do not think about their materials in terms of the fields offered. This is particularly the case with users who teaches modern languages. For example, if the user wants to add a picture of a cat to the assetbase, the user must specify which language and level of competency the material should be used for. While such information on an asset may be appropriate for a whole course, these fields are clearly not relevant for such low-level materials such as pictures. Furthermore, such material can be useful for authoring lessons or exercises for a wide range of subjects, from modern languages, art and even physics! Consequently some fields demand information, which are too specific for certain materials. Ironically, highly specific tags may prevent materials from being widely used; contradicting the notion that metadata was introduced to allow greater sharing and reuse of materials.

3.3 MALTED Metadata Interface

The design of dialogues dealing with metadata in MALTED has to solve the following problems:

- How to present large number of fields without overwhelming the user?
- How to get the user to complete the fields as quickly and accurately as possible?
- How to reduce the number of fields to be filled in by the user?
- How to determine which fields are relevant for a certain material?

3.3.1 Automatic Field Completion

There are a number of fields that can be automatically completed by the system. These are information that can be derived from the file system, such as file size, file format and other technical information. MALTED automatically fills these fields in for the user when the material is submitted. If the user is adding a course to the assetbase, all the assets in that course inherit the tagging from that course.

3.3.2 Reduction of the number of fields

MALTED reduces that number of fields for a material by displaying only the fields that are relevant to the type of material being added. Taking an earlier example, MALTED will not prompt the user for information concerning "Image Resolution" if the user is adding a text or an audio file to the assetbase. This helps to reduce the problem of having too many and/or irrelevant fields. Additionally, MALTED differentiates between mandatory fields and optional fields by hiding optional fields from the user unless the user explicitly requests to fill in those fields.

A possible counter-argument against reducing the number of fields can emerge from what has already been discussed in *Section 3.1: Searching for Material*. Large numbers of fields allow the user to define a search very specifically. There will always be a case where a user might want to search for materials under an obscure field, such as the "Semantic Density" and the "TaxonPath" of a material (LOM schema). However, by attempting to satisfy every possible use of metadata, the metadata schemas such as LOM may have made themselves unusable to small-scale or individual users.

4 Discussion

While the MALTED project has not been able to solve all the usability problems concerning metadata that it has encountered, it has managed to highlight issues that require further debate and enquiry. From a broader perspective, during the development of MALTED, knowledge about what functionalities are

required by language teachers when authoring electronic multimedia materials has been acquired. This in turn has raised the issue of the appropriateness of educational metadata schema in relation to how language teachers actually go about creating teaching materials.

4.1 Material Usage and Metadata

Problems discussed in Section 3, such as over-demand and overload of both relevant and irrelevant information about assets, raise the possibility that sharing and reuse of educational materials between users happens at a much lower level of granularity. In the case of MALTED, users just want to pick out elements of a course or just find a single diagram that they can use in their own question. The LOM metadata schema suggests that users would want to reuse other people's whole exercises or even courses. This raises a fundamental question concerning how teachers and lecturers go about authoring their teaching materials and what kind of computer support they actually require.

4.1.1 Syllabus and Instructional Goals

The current view of the teacher's task, in which constructing teaching material is one of adapting an existing course created by someone else to suit an area of the syllabus that he/she is trying to cover. The LOM metadata schema codifies the course in terms of the syllabus that the course is covering. This assumes that what the teacher is trying to accomplish in class – instructional goals – is very similar to the syllabus or at least derivable just from the syllabus. However, in the case of language teachers (users of MALTED), the task they engage in is a very different one. Instead of finding a course or exercise that deals with a certain part of the syllabus and adapting their instructional goals to suit the course/exercise, language teachers approach material authoring from the opposite end. That is, they first form a set of instructional goals and then find materials – such as pictures, audio or a particular element of an exercise (e.g. time-telling elements of an exercise) but **not** a whole exercise or course – that can fulfil or be adapted for each individual instructional goal. The main reason for this "reversed" approach is because language teachers feel that they need to know the students' abilities first before writing instructional goals that would be the road map for those students to accomplish what the syllabus have set out.

While the goal of creating teaching materials by reusing previously authored materials is the same in both cases, the sub-goals or how the main goal is achieved are very different. Teachers are not looking for "ready-made" courses or exercises to use. Users of MALTED feel that it is their responsibility as teachers to identify the instructional goals for their students. Moreover, other people's exercises may cover the right part of the syllabus but not necessary via the most appropriate instructional goals. Supporting the task model where the instructional goals are set by someone else would be a critical failure to support the correct sub-goals.

5 Conclusion

While it was very important to solve technical problems encountered during the implementation of MALTED, the issues of the usability of metadata management facilities in MALTED are very significant factors in determining whether the system will be used or not by the teaching profession.

While extensive metadata schema for educational materials facilitates very accurate search queries, the schema has serious usability problems from the end-user's (teacher/lecturer) point of view when contributing new materials to an archive. In order to use the extensive LOM metadata schema, a professional archive manager will be needed to perform the tagging as the process is too time consuming for the teachers to do themselves. MALTED uses a subset of the LOM schema that can be mapped to the more extensive schema.

A significant finding during the MALTED project is that language teachers reuse materials at a much lower level of granularity than LOM metadata schema would suggest. Language teachers write instructional goals based on the abilities of their students then find materials that would satisfy the

pedagogic needs of those instructional goals. Separate assets of a course or exercise, such as pictures or audios, are individually picked out by the teachers and are used to author a new course or exercise. Consequently, the user requires authoring support at a much lower level of granularity. While the highest possible level of granularity of reuse is using a whole pre-authored course, language teachers hardly reuse courses by adapting them. They reuse smaller components of courses that are appropriate for instructional goals that have been set by the teachers themselves. This model of usage may also be applicable to other cases where teachers reuse multimedia materials from resources other than their own. It may also be applicable to other subject areas and other levels of education.

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Dublin Core Metadata Initiative -- http://purl.oclc.org/dc/index.htm

IEEE Learning Technology Standards Committee (LTSC) Learning Object Model (LOM) Working Group -- http://ltsc.ieee.org/wg12/index.html

MALTED -- http://malted.cs.ucl.ac.uk/uk/

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